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Tracking accelerated aging of composites with ultrasonic attenuation measurements

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Composite materials are steadily replacing traditional materials in many industries. Durability is a critical limitation for many advanced composite materials, particularly in aerospace applications. Lawrence Livermore National Laboratory has assembled an extensive capability to accelerate the aging process in composite materials so that durability limits can be determined in reasonable amounts of time. Ultrasonic attenuation is a convenient method to nondestructively track the progression of damage caused by long-term thermal and mechanical loads on fiber-polymer composite materials.

We characterized a series of fiber-polymer composite samples at five different temperatures up to 300°C, each aged up to 2000 hours under different chemical environments. Ultrasonic attenuation correlates with aging damage before major defects appear. Each material tested has a different threshold temperature below which there is insufficient damage to cause an increase in attenuation. Chemical analysis of the same series of materials confirms the damage trend that ultrasonic attenuation measurements suggest. The accelerated damage states are compared to damage states brought on by real-time aging to determine equivalent loading temperatures, time duration and stresses.

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